REMARKS

Reconsideration and allowance of this application, as amended, are respectfully requested. The written description and claims 37, 88, and 112 have been amended. Claims 1-183 remain pending in the application, with claims 1-36, 45-59, 61, 73-87, 118, 129, and 132-183 withdrawn from consideration as directed to a non-elected invention. The rejections and objections are respectfully submitted to be obviated in view of the amendments and remarks presented herein.

In the Amendment, the written description has been editorially amended as required by the Office Action. Each of the informalities identified in the objection to the disclosure has been corrected. Withdrawal of the objection to the disclosure is respectfully requested.

Claim 37 has been amended to recite in pertinent part "a source of releasable hydrogen within said enclosure, *said releasable hydrogen capable of pressurizing the space within said enclosure to a pressure above the pressure associated with said first gas.*" Support for claim 37 is found throughout Applicants' application, but is found initially in the general disclosure at specification page 4, line 19, through page 5, line 8 ("The invention, therefore, is directed to manufacturable processes and the resultant structures that utilize a metal hydride as an internal source of hydrogen in order to enhance heat removal within semiconductor packages. The invention employs relatively high pressure hydrogen gas or hydrogen-helium gas mixtures to fill a hermetically-sealed module or envelope surrounding the chip or chips in an electronic

package. The use of a metal hydride that can be heated by internal or external means facilitates pressurizing the hydrogen gas or hydrogen-helium gas mixtures within the hermetically-sealed package to pressures of from about 5 MPa to about 50 MPa or higher. Because the thermal conductivities of hydrogen and helium increase approximately linearly with their pressure at values well below their critical points, the use of elevated pressure is particularly beneficial."). Claims 88 and 112 have been amended to recite in pertinent part "a source of releasable hydrogen within said enclosure, *said releasable hydrogen capable of pressurizing the space within said enclosure to a pressure above the first pressure.*" Entry of each of the amendments is respectfully requested.

Objections to the Drawings

The objections to the drawings are traversed in part, as follows.

The Office Action states that "[i]n Fig. 7A, the reference numeral '220' is not disclosed . . ." In fact, reference number 220 is disclosed in paragraph 00103, line 2.

The Office Action states that "[i]n Fig. 7C, the reference numeral '230' is not disclosed . . ." In fact, reference number 230 is disclosed in paragraph 00103, line 5.

The Office Action states that "[i]n Fig. 7E, the reference numeral '240' is not disclosed . . ." In fact, reference number 240 is disclosed in paragraph 00103, line 10.

The Office Action states that "[i]n Fig. 10A, the reference numerals '1020' and '1040' are not disclosed . . ." In fact, reference number 1020 is disclosed in paragraph 00104, line 3, and reference number 1040 is disclosed in paragraph 00104, line 6.

The Office Action states that "[i]n Fig. 10B, the reference numeral '1110' is not disclosed . . ." In fact, reference number 1110 is disclosed in paragraph 00105, line 8.

The Office Action states that "[i]n Figs. 12, 13D and 19, the reference numeral '635' is not disclosed . . ." In fact, reference number 635 is disclosed in paragraph 00115, line 3.

The Office Action states that "[i]n Fig. 13A, the reference numeral '620' is not disclosed . . ." In fact, reference number 620 is disclosed in paragraph 00113, line 4.

Each of the other objections to the drawings has been addressed by editorially amending the written description. No new matter has been added. Withdrawal of the objection to the drawings is respectfully requested.

35 U.S.C. § 101

Claims 37-131 stand rejected under 35 U.S.C. § 101. The Office Action asserts that "the disclosed invention is inoperative and therefore lacks utility." In support of this assertion, the Office Action states that "Bridenbaugh et al. [U.S. Patent No. 5,744,733], cited herein for evidence purposes, clearly discloses in column 1, line 14 – column 2, line 49 the hydrogen in a hermetically sealed semiconductor package accelerates failure and substantially

increases the probability of infant mortality, i.e., the occurrence of early failures after deployment by an end user."

The rejection is respectfully traversed. Bridenbaugh discloses the following (in the Abstract):

> The specification describes a test procedure *for evaluating the susceptibility of electronic and photonic device packages to degradation effects caused by ambient hydrogen* in the device package during the service life of the packaged device. *The test procedure uses a hydrogen soak in which the subassembly parts are immersed in high concentrations of hydrogen gas* at moderately elevated temperatures. The hydrogen gas is preferably diluted with an inert gas such as nitrogen or argon for safety in handling and processing. *The test procedure can be used to screen components once their susceptibility to hydrogen attack has been established* (emphasis added).

Bridenbaugh, therefore, is directed to "techniques for testing and screening components, typically electronic and electro-optic components and IC assemblies, to determine the degree of risk of these components to long term failure due to hydrogen corrosion" (column 1, lines 7-11). Bridenbaugh discloses "an empirical process for screening piece parts and components *to determine the susceptibility of those parts to degradation and failure* due to the presence of hydrogen" (column 2, line 67, through column 3, line 3) (emphasis added).

The Office Action provides no explanation whatsoever to support the assertion that Bridenbaugh renders Applicants' invention "inoperative." Bridenbaugh's process screens "piece parts and components *to determine the susceptibility of those parts to degradation and failure* due to the presence of hydrogen." Some of the parts screened will in all likelihood be determined to be susceptible, and others will be determined to be not susceptible. Applicants' invention can employ parts that are not susceptible to hydrogen.

Applicants' invention is fully operative, as is evident from the specification. See, for example, the disclosure at page 12, lines 9-12: "A large number of candidate metal hydrides are available for the various embodiments of the invention described herein. Hydride selection depends upon factors such as the *package type*, number of chips contained in each package, and *joining* and temperature *processes*" (emphasis added). See also the disclosure at page 15, lines 19-20: "In all cases, the presence of hydrogen will facilitate welding, brazing, or otherwise providing excellent hermetic joints." Reconsideration and withdrawal of the rejection under § 101 are respectfully requested.

35 U.S.C. § 102(b) - Bloom

Claims 37-44, 60, 62-65, 68-71, 88-102, 105-117, 119-124, 127, 128, 130, and 131 stand rejected under 35 U.S.C. § 102(b) as allegedly being anticipated by U.S. Patent No. 5,569,958 to Bloom. The Office Action asserts that "[r]egarding claim 37, Bloom discloses in Fig. 4, Fig. 5, column 1, lines 7-21 and column 8, lines 21-40 a semiconductor package comprising:

-a hermetically sealed enclosure (80 and 70) surrounding said package;

- a semiconductor chip (any component on area 60) within said enclosure;

- a first gas within said enclosure; and

- a source of releasable hydrogen (30) within said enclosure."

Regarding claim 62, the Office Action asserts that "Bloom discloses in Fig. 4, Fig. 5, column 1, lines 7-21 and column 8, lines 21-40 a semiconductor package comprising:

- a hermetically sealed enclosure (80 and 70) surrounding said package;

- a semiconductor chip (any component on area 60) within said enclosure;

- a source of releasable hydrogen (30) within said enclosure; and

- a gas at an elevated pressure within said enclosure,

- said gas comprising a first gas component and a second gas component, wherein said second gas component results form the release of said releasable hydrogen, and wherein said first gas component is initially present within said enclosure prior to the release of said releasable hydrogen, and said first gas component is initially present at a pressure lower than said elevated pressure."

Regarding claim 88, the Office Action asserts that "Bloom discloses in Fig. 4, Fig. 5, column 1, lines 7-21 and column 8, lines 21-40 a semiconductor chip comprising:

-a hermetically sealed enclosure (70 and 80) surrounding said chip;

- an integrated circuit (any components on 21) within said enclosure;

- a gas at a first pressure within said enclosure; and

- a source of releasable hydrogen (30) within said enclosure."

Regarding claim 99, the Office Action asserts that "Bloom discloses in Fig. 4, Fig. 5, column 1, lines 7-21 and column 8, lines 21-40 a semiconductor chip comprising:

- a hermetically sealed enclosure (70 and 80) surrounding said chip;

- an integrated circuit (any components on 21) within said enclosure;

- a source of releasable hydrogen (30) within said enclosure; and

- a gas at an elevated pressure with said enclosure,

- said gas comprising a first gas component and a second gas component, wherein said second gas component results from the release of said releasable hydrogen, and wherein said first gas component is initially present within said enclosure prior to the release of said releasable hydrogen, and said first gas component is initially present at a pressure lower than said elevated pressure."

Regarding claim 112, the Office Action asserts that "Bloom discloses in Fig. 4, Fig. 5, column 1, lines 7-21 and column 8, lines 21-40 a semiconductor chip comprising:

- a hermetically sealed enclosure (70 and 80) surrounding said chip;

- a gas at a first pressure within said enclosure; and

-a source of releasable hydrogen (30) within said enclosure."

Regarding claim 121, the Office Action asserts that "Bloom discloses in Fig. 4, Fig. 5, column 1, lines 7-21 and column 8, lines 21-40 a semiconductor chip comprising:

-a hermetically sealed enclosure (70 and 80) surrounding said chip;

- a source of releasable hydrogen (30) within said enclosure; and

-a gas at an elevated pressure within said enclosure,

- said gas comprising a first gas component and a second gas component, wherein said second gas component results from the release of said releasable hydrogen, and wherein said first gas component is initially present within said enclosure prior to the release of said releasable hydrogen, and said first gas component is initially present at a pressure lower than said elevated pressure."

Each of the grounds of rejection is respectfully traversed. For at least the following reasons, the disclosure of Bloom does not anticipate Applicants' claimed invention.

First, as indicated in the introductory remarks, claim 37 has been amended to recite in pertinent part "a source of releasable hydrogen within said enclosure, *said releasable*

hydrogen capable of pressurizing the space within said enclosure to a pressure above the pressure associated with said first gas." Applicants' claim 37, therefore, defines a semiconductor package comprising, *inter alia*, a source of releasable hydrogen that is capable of pressurizing the space within said enclosure to a pressure above the pressure associated with said first gas. As also indicated above, support for claim 37 is found throughout Applicants' application, but is found initially in the general disclosure at specification page 4, line 19, through page 5, line 8:

> The invention, therefore, is directed to manufacturable processes and the resultant structures that utilize a metal hydride as an internal source of hydrogen in order to enhance heat removal within semiconductor packages. The invention employs relatively high pressure hydrogen gas or hydrogen-helium gas mixtures to fill a hermetically-sealed module or envelope surrounding the chip or chips in an electronic package. The use of a metal hydride that can be heated by internal or external means facilitates pressurizing the hydrogen gas or hydrogen-helium gas mixtures within the hermetically-sealed package to pressures of from about 5 MPa to about 50 MPa or higher. Because the thermal conductivities of hydrogen and helium increase approximately linearly with their pressure at values well below their critical points, the use of elevated pressure is particularly beneficial.

Applicants' claimed structure is different from that disclosed by Bloom. Bloom discloses hermetic vias, not Applicants' claimed "hermetically sealed enclosure" surrounding a semiconductor package. Bloom discloses "an electronic component base with a via fill composition that is capable of deforming to accommodate dimensional changes in both the base and fill composition without loss of hermeticity, which occur as a result of heating to

elevated temperatures," and that "this composition includes an effective amount of an appropriate metal, up to about 10% of at least one active agent and an organic vehicle." The active agent is described by Bloom as including hydrides (column 5, lines 36-49). In the Example relied upon by the Office Action, Bloom discloses a "silver-based fill composition" in which the active agent is "1% titanium hydride" (column 8, lines 21-39).

But, Applicants' claimed "source of releasable hydrogen" clearly distinguishes over the active agent (e.g., hydride) disclosed by Bloom. It is clear from Bloom's disclosure that the active agent is used to facilitate the preparation of the fill composition, not to provide a source of releasable hydrogen "capable of pressurizing the space within said enclosure to a pressure above the pressure associated with said first gas," as claimed. In fact, Bloom discloses that "[i]t is generally preferred to utilize relatively small particles of the active agent to promote dispersion of the agent throughout the via fill composition. The via fill compositions are generally formed by combining the powdered metal(s) and active agent(s) with the organic vehicle and mixing until a pasty consistency is obtained" (column 6, lines 10-15). See also Bloom column 5, lines 41-44, where the active agent is described in the context of soldering and brazing ("Two informative works on active agents are, 'Principles of Soldering and Brazing', Humpston, G. and Jacobson, D., ASM Int., page 164, 1993; and 'Brazing', Schwartz, M., ASM Int., page 120, 1987, which are herein incorporated by reference."). The active agent is not disclosed as being capable of generating hydrogen gas, as claimed. There is no teaching or suggestion whatsoever in Bloom of Applicants' claimed "source of releasable

hydrogen within said enclosure, *said releasable hydrogen capable of pressurizing the space within said enclosure to a pressure above the pressure associated with said first gas.*"

The claims dependent from claim 37 are allowable along with claim 37, and on their own merits.

Independent claims 88 and 112 are similarly allowable. Each of claims 88 and 112 recites in pertinent part "a source of releasable hydrogen within said enclosure, *said releasable hydrogen capable of pressurizing the space within said enclosure to a pressure above the first pressure.*" Bloom fails to anticipate the claimed invention. The claims dependent from claims 88 and 112 are allowable along with the base claims, and on their own merits.

Independent claims 62, 99, and 121 are also allowable. Claim 62 recites, for example, "a source of releasable hydrogen within said enclosure; and a gas at an elevated pressure within said enclosure, said gas comprising a first gas component and a second gas component, wherein said second gas component results from the release of said releasable hydrogen, and wherein said first gas component is initially present within said enclosure prior to the release of said releasable hydrogen, and said first gas component is initially present at a pressure lower than said elevated pressure." Bloom neither teaches nor suggests the claimed feature of the source of releasable hydrogen. The claims dependent from claims 62, 99, and 121 are allowable along with the base claims, and on their own merits.

For at least the above reasons, reconsideration and withdrawal of the rejection under § 102(b) are respectfully requested.

35 U.S.C. § 103(a) – Bloom in view of Han; Bloom in view of Polak

Claims 66, 67, 103, 104, 125, and 126 stand rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Bloom in view of U.S. Patent No. 6,281,135 to Han et al. Claim 72 stands rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over Bloom in view of U.S. Patent No. 5,689, 089 to Polak et al.

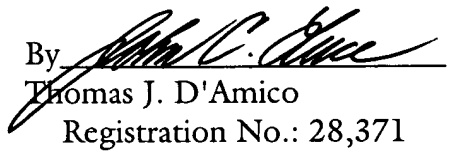
For all of the reasons identified above with respect to the rejection under § 102(b), each of the rejections under § 103(a) is similarly respectfully traversed. The Office Action relies upon Han and Polak for their purported teachings related to limitations such as Applicants' claimed gas compositions and pressures. Regardless of any such teachings, neither of the secondary references rectifies the deficiency associated with Bloom, i.e., the failure to anticipate Applicants' claimed structure having, *inter alia*, a "source of releasable hydrogen within said enclosure, *said releasable hydrogen capable of pressurizing the space within said enclosure to a pressure above the pressure associated with said first gas.*" Thus, the asserted combinations of disclosures would not have rendered obvious the embodiments of the invention defined by any of the rejected claims.

In view of the above, each of the presently pending claims in this application is believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully

requested to withdraw the outstanding rejection of the claims and to pass this application to issue.

Dated: April 18, 2003

Respectfully submitted,

By 

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